



# Newsletter

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## Director's Note

Postdoctoral associates have been major contributors to our research program since the Institute opened in 1983. From that time through the present, 24 scientists with recent doctoral degrees have spent from one to three years at IES, pursuing their own research interests while working on one or more projects with Institute colleagues. This period, free of teaching and administrative responsibilities, gives the scientists the opportunity to establish themselves in the scientific community, through collaboration and publication.

At present there are six postdoctoral associates at the Institute. One, Dr. Joseph Boyer, whose research on groundwater quality was the subject of an article in the November-December 1992 issue of the *IES Newsletter*, recently has accepted a position at Florida International University and will be moving there this spring. The research of two other postdoctoral associates, Dr. Karin Limburg and Dr. Cathleen Wigand, focuses on aspects of the Hudson River Ecosystem and is featured in this issue's cover story.

The IES Newsletter is published by the Institute of Ecosystem Studies, located at the Mary Flagler Cary Arboretum in Millbrook, New York. All newsletter correspondence should be addressed to the editor.

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## IES Postdoctoral Associates Expand Research on the Hudson River

### The Animals ...

It is common knowledge that the age of a tree can be determined by counting growth rings in the trunk. What is not so widely known is that there exist structures in the inner ear of fish that provide even more precise growth records. These earstones, called otoliths, are minute structures of protein and calcium carbonate that increase in size by a new ring each day. A patient scientist equipped with fine dissection pins and a microscope can examine the rings to determine not only the age of young fish but also, by noting the width of the rings, how well-nourished the fish was.

Dr. Karin Limburg, a postdoctoral associate at the Institute, interpreted American shad otoliths as part of her doctoral research, and is now applying her experience to a study of other species of Hudson River fish. She and IES aquatic ecologist Dr. Michael Pace, who is doing ongoing research on the role played by zooplankton in the river ecosystem, are hoping to determine how the annual population explosion of zooplankton in the Hudson River affects larval fish.

The fish that Dr. Limburg is studying are white perch, year-round residents of the Hudson River, and striped bass, which spawn in the fresh waters of the river but spend most of their adult life at sea. These closely related species are key components of the river's food web. The dominant type of zooplankton in the river is *Bosmina*, of the order Cladocera (water fleas); with an approximate length of 0.5 mm (0.02 in.), these animals are just barely visible to the unaided eye. *Bosmina* feed on bacteria and microscopic algae, and each year during the first three weeks of June have a period of rapid reproduction, known as a "bloom". *Bosmina* appears to be an important food for fish that have just hatched, and Drs. Limburg and Pace wanted to learn if those fish whose larval development coincides with the zooplankton bloom grow and survive better than fish that do not overlap with the bloom.

Summer 1994 was the first year of the study. Samples were collected at three stations in the Hudson River — at Kingston, New Hamburg and Haverstraw Bay, near Croton — using twin fine-mesh nets towed behind the Institute's research vessel. Collections were done at intensive intervals from May through early July, to bracket the zooplankton bloom. Fish larvae and zooplankton were caught in the nets and brought back to the laboratories. Research assistant Mr. David Fischer was responsible for doing the zooplankton counts, while Dr. Limburg studied the fish.

When they hatch, white perch are 2.5 - 3.5 mm (0.1 - 0.12 in.) long and striped bass are 4 - 5 mm (0.16 - 0.2 in.) long. At this stage the two species are very difficult to tell apart, with patterns of pigment cells and the arrangement of internal organs and skeletal elements being the only distinguishing features. After identifying each fish larva, Dr. Limburg extracted the largest of the three otoliths present on each side of the tiny head, and analyzed the stomach contents to determine the species of zooplankton present\*. She then could look for correlations between the numbers and/or species of zooplankton she found in the fish, and those Mr. Fischer found in the

*\* Frequently, answering one question in science presents exciting new questions. While analyzing stomach contents, Dr. Limburg found that white perch had been feeding on the veligers (larvae) of zebra mussels on two of the sampling dates. This predation on zebra mussel larvae had not been documented previously.*

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Dr. Karin Limburg points to a juvenile striped bass; a juvenile white perch is behind the bass.

TOM TAFT



## Hudson River, *continued*

river water. Not surprisingly, the timing and magnitude of *Bosmina* blooms were reflected by the fishes' diets. She also will count the otolith rings to determine the age of the larvae, and measure their width to see if fish grew most during these blooms.

Dr. Limburg also is interested in knowing what fish do in a year with low *Bosmina* numbers. 1993 was such a year in the Hudson River, due to high rates of feeding by zebra mussels on zooplankton. By law, power companies located along a river must monitor fish populations, and from utility consortium scientists Dr. Limburg has been able to obtain fish collected from the Hudson River in 1993. She will be analyzing their stomach contents and otoliths.

### The Plants ...

In freshwater and marine ecosystems, beds of aquatic grass act as nurseries for juvenile fish and for invertebrate animals. In the Hudson River, growing at depths of up to 3 meters (just under 10 feet), the native wild celery is an especially important plant — not only do wild celery beds provide habitat for zooplankton, crayfish and fish, among other animals, but the plants are food for ducks and geese. Wild celery (known also as water celery) is one of the only native species of submersed plants still common in freshwater areas.

Dr. Cathleen Wigand (above right) did her doctoral research on wild celery in the Chesapeake Bay, where she discovered a symbiotic fungus associated with the plant's roots. Mycorrhizae, the general term describing a symbiotic association between a fungus and the root system of a plant, are present in 80% of land plants but had not been documented previously in aquatic plants of North America. The fungi are important to wild celery because they facilitate the uptake of phosphate, an essential nutrient that may give the plant a competitive advantage over invasive exotic species. On the other hand, wild celery provides an environment that is favorable for fungal growth. The plant has evolved a mechanism whereby its roots release oxygen to the sediments, and since it is difficult for fungi to survive in sediments where oxygen levels are low, this release of oxygen into the root zone makes it possible for mycorrhizae to exist there.

Dr. Wigand has found that Hudson River wild celery plants also have a symbiotic relationship with a fungus. As a post-doctoral associate at the Institute, she is collaborating with aquatic ecologist Dr. Stuart Findlay to study the biogeochemistry of grassbeds in the Hudson River. She will



measure nutrients — ammonium, phosphate and nitrate, for example — and metals to compare sediment chemistry in beds of native vs. exotic aquatic plants, as well as in vegetated vs. unvegetated sediments.

The experiments will be done at grassbed sites from Haverstraw Bay north. Once the scientists understand what is essential in sediments to promote the growth of the native species, they can recommend strategies — sediment conditioning, for example — to favor the reintroduction of native plants.

For part of this spring and summer, Dr. Wigand will visit Denmark to collaborate with Danish scientists on the distribution of aquatic mycorrhizae in lakes. The work in Denmark will complement her mycorrhizal research in the Hudson River.

### Proposed Zebra Mussel Study

Drs. Limburg and Wigand currently are investigating the feasibility of a collaborative project to learn how experimental ecosystems of varying complexities are affected by zebra mussels. They envision using four different mesocosms — 500 gallon tanks, for example — that are larger than an aquarium but smaller than a pond. These would simulate four different ecosystems: plankton and sediment; plankton, sediment and grass; plankton, sediment and fish; and plankton, sediment, grass and fish. Zebra mussels would be added to one set of the mesocosms while the other set would be untreated, thereby

serving as controls for the experiment. By comparing each experimental ecosystem, the scientists would hope to learn more about the effects that zebra mussels have on system productivity, nutrient levels and plant and animal populations.

\* \* \* \* \*

*Typically, post-doctoral associates spend two years at the Institute as a collaborator with a staff ecologist on an existing research project, or as a Cary Postdoctoral Associate doing a project of his or her own design supported by the Institute with funding from the Mary Flagler Cary Charitable Trust.*

*Dr. Karin E. Limburg graduated from Vassar College in 1977.*

*While a student there, she was one of the first of the Mary Flagler Cary Arboretum summer students, doing a study of the East Branch of Wappinger Creek. Later, as a graduate student at Cornell University, she was a Polgar Fellow at IES, working with Dr. David Strayer. After receiving her Ph.D. in ecology and evolutionary biology from Cornell, she was hired by Dr. Michael Pace to do postdoctoral studies as a collaborator on his Hudson River studies. In addition to the work described above, she and Dr. Pace have just received funding from the Hudson River Foundation to study the otoliths of spawning American shad to determine migration history.*

*Dr. Cathleen Wigand has a Ph.D. in aquatic ecology from the University of Maryland, where research on the Chesapeake Bay ecosystem led to her discovery of a symbiotic fungus associated with the roots of wild celery. A Cary Postdoctoral Associate, she arrived at the Institute in November 1994. As part of her work at the Institute, Dr. Wigand will be documenting distribution and species composition of aquatic plants in the Hudson River, a project done in collaboration with Dr. Stuart Findlay and funded in part by grants from the National Oceanographic and Atmospheric Administration and the Hudson River Foundation.*

### CELEBRATE EARTH DAY

at the  
Institute of Ecosystem Studies  
and  
Farm and Home Center  
**Saturday, April 22**  
Call 914/677-5359 for details



# IES Acts on Need for Ecosystem Course

Few universities can present ecosystem ecology with the breadth and depth available at IES. Recognizing this, Institute scientists first offered an intensive graduate-level course in 1989, and "Fundamentals of Ecosystem Ecology" has been given biennially since then. IES ecologist Dr. Kathleen Weathers and visiting scientist Dr. Richard Pouyat, U.S. Department of Agriculture Forest Service, coordinated this year's program.

For two weeks in January, 15 master's and doctoral degree students from across the U.S. immersed themselves in ecosystem science. Sixteen of the Institute's scientists, including Drs. Weathers and Pouyat, were lecturers in their areas of expertise. Daily lectures were grouped under four major headings, a strategy designed to give the students a clear and well-structured perspective of the subject. Starting with "Fundamentals", students received an introduction to ecosystem processes — primary production, nutrient cycling etc. Then, under "Methods", Institute instructors discussed the latest techniques used in ecosystem research. Armed with this information, the class was ready for "Synthesis", to learn how to integrate the previously learned concepts with ecological theory. Last of the major sections was "Applications", to demonstrate to the students how what they had learned applies to the real world.

Students were expected to read one or two research papers on the subject of each lecture, and, once in the classroom, they spent equal time in lecture and group discussion. Not all the learning was in the



*"Fundamentals of Ecosystem Ecology" students and program coordinators, January 1995:*  
*Front, l. to r.: Mary Savin, U. of Rhode Island; Rebecca Fuller, Michigan State U.; Joaquin Chaves, U. of Rhode Island; Wendy Sproull, Massachusetts Inst. of Technology; Deborah Chiavelli, U. of Mississippi; Kathleen Weathers (coordinator), IES; Kristina Bacon, U. of Rhode Island*  
*Back, l. to r.: Angela Salvemini, Rutgers U.; Puja Batra, W.K. Kellogg Biological Sta., Mich.; James Baxter, Rutgers U.; Mary Cadenasso, Rutgers U. and IES; Jeffrey Dudycha, W.K. Kellogg Biological Sta., Mich.; Robert Baca, U. of Mississippi; John Kim, U. of Massachusetts; Jodi Lyons, U. of Rhode Island; Richard Pouyat (coordinator), IES. Absent from photo: Roxanne Marino, Cornell U.*

classroom, however: the class also traveled to the Institute's Urban-to-Rural Gradient Study sites in the Bronx, Westchester County and Litchfield County (Connecticut) to observe field work techniques.

Grades were determined by class participation, the three-hour final examination and the final project. For this project, students were challenged to play the role of members of a National Science Foundation (NSF) review panel — scientific peers who determine the merits of a proposed study and decide whether or not to award a research grant. Drs. Weathers and Pouyat

assembled 15 proposals from IES files, and each student, acting the part of an NSF reviewer, presented one proposal to the group and reviewed two others. Putting into action the concepts they had learned during the course, the students concluded the exercise by debating the relative ecological significance and merit of each proposal, knowing that only the top five could be "funded".

"Fundamentals of Ecosystem Ecology" is taught every other year. The Institute's fifth such graduate-level program is already on the calendar for January 1997.

## Dr. Pace Honored

The American Association for the Advancement of Science (AAAS) has elected IES aquatic ecologist Dr. Michael L. Pace (right) to the rank of AAAS Fellow. Annually since 1874, the AAAS Council has elected as Fellows members of the association whose "efforts on behalf of the advancement of science or its applications are scientifically or socially distinguished", according to a letter from Mr. Richard S. Nicholson, AAAS executive officer.

Dr. Pace was honored for his "major advances in understanding controls on aquatic food webs and for integrating microorganisms into ecosystem models".



## IES SPRING AQUATIC ECOLOGY CAMP

**Mon., April 17 through Thurs., April 20**

Here is the chance for 7th and 8th grade students to become aquatic ecologists during their spring vacation!

With a small team of fellow adventurers, campers will explore pond and stream, learn how aquatic ecosystems work, hike, observe plants and animals, do experiments and create nature art projects.

The 12 campers will be guided by two experienced IES educators.

**Cost: \$96 per student**

**Registration deadline: April 3**

**Call: 914/677-5359**

*Applicants will be accepted on a first-come, first-served basis.*



## Calendar

### CONTINUING EDUCATION

Winter/Spring semester catalogues, with a complete listing of courses and course descriptions, are available from the Gifford House. Among the offerings are the following workshops and trips:

#### Workshops

Mar. 18: **Managing Invasive Non-Native Plants**  
Apr. 8: **Managing a Collector's Garden**  
May 6: **Restoring Nature to the Residential Landscape**

#### Flower Shows and Garden Tours

June 24 & 25: **Longwood and Winterthur Gdns.**

#### Ecological Excursions

May 6: **Ethnobotany and American Indian Heritage**  
May 13: **Ecology of a Floodplain Forest Community: Canoe Exploration of the Great Swamp** [Full — waiting list only]  
June 3: **Ecology of the Shawangunks and Exploration of the Ancient Ice Caves**  
June 10: **Wander the Wappinger Creek**  
June 11: **Spring in the Berkshires: Nature Interpretation at the Berkshire Sanctuaries**  
June 24: **White Memorial Conservation Center and White Flower Farm**

Call 914/677-9643 to register, request a catalogue, or learn about courses and certificate programs.

### ESPECIALLY FOR CHILDREN IES Spring Aquatic Ecology Camp

Monday, April 17 through Thursday, April 20, for up to 12 students in grades 7 and 8. See the box on page 3 of this newsletter for details. Call the IES Education Program Office at the number below for more information or to register.

### SUNDAY ECOLOGY PROGRAMS

Free public programs are held on the first and third Sunday of each month, except over holiday weekends. Last-minute changes are sometimes unavoidable, so call 914/677-5359 to confirm the day's topic. In case of poor weather, call 677-5358 after 1 p.m. to learn the status of the day's program. The following programs begin at 2 p.m. at the Gifford House, except as otherwise noted:

Mar. 19: **The Importance of Microbes in the Marsh**, a demonstration and walk led by Dr. Cathleen Wigand  
Apr. 2: **What *Have* We Done?... The Impacts of Humans on Ecosystems**, a talk by Ms. Mary Cadenasso  
May 7: **Signs of Spring**, a walk led by Ms. Ana Ruesink

*We strongly recommend that participants in outdoor programs wear sturdy, waterproof footwear and long pants tucked into socks.*

### IES SEMINARS

The Institute's program of free scientific seminars features presentations by visiting scientists each Friday at 3:30 p.m. at the IES Auditorium:

Mar. 17: **The Structure of Sub-surface Flow: From Pore to Formation Scale**, Dr. Robert Glass, Sandia National Lab, Albuquerque  
Mar. 24: **The Use of Stable Isotopes in the Analysis of Food Webs**, Dr. Brian Fry, Florida International University, Miami  
Mar. 31: **Topic: Plant communities, competition experiments and statistics**. Speaker: Dr. Jessica Gurevitch, SUNY Stony Brook  
Apr. 7: **Shrew Community Ecology: Why Are There So Many Kinds of Shrews?**, Dr. Gordon L. Kirkland, Jr., Shippensburg Univ., Penn.  
Apr. 14: **Ecological Controls Over Hydrocarbon Emission from Vegetation**, Dr. Marvel Lerdau, SUNY Stony Brook

### GREENHOUSE

The IES greenhouse, a year-round tropical plant paradise and a site for controlled environmental research, is open until 4:00 p.m. daily except public holidays. Admission is by free permit (see below).

### IES GIFT AND PLANT SHOP

#### New in the Shop ...

... winter-weight, garment-dyed-green IES sweatshirts  
... locally-made dried flower wreaths, potpourri and hand-dipped beeswax candles ... **and for children...**  
'furry' forest animals (fox, squirrel, deer and more)  
**Senior Citizens Days:** 10% off on Wednesdays

### HOURS

Winter hours: **October 1 - April 30**

**Closed on public holidays.**

Public attractions are open Mon. - Sat., 9 a.m. - 4 p.m. & Sun. 1 - 4 p.m.; trails and roadways are closed when snow-covered or icy.

The **IES Gift and Plant Shop** is open Mon. - Sat., 11 a.m. - 4 p.m. & Sun. 1 - 4 p.m. (The shop is closed weekdays from 1 - 1:30 p.m.)

\* All visitors must pick up a free permit at the Gifford House Visitor and Education Center on Route 44A for access to IES public attractions. Permits are available until 3 p.m. daily.

### MEMBERSHIP

Become a member of the Institute of Ecosystem Studies. Benefits include a member's rate for IES courses and excursions, a 10% discount on Gift Shop purchases, a free subscription to the IES Newsletter, and participation in a reciprocal admissions program, with benefits at over 100 nature centers, forest preserves, gardens and conservatories in the U.S. and Canada. Individual membership is \$30; family membership is \$40. For information, call Ms. Janice Claiborne at 914/677-5343.

**The Institute's Aldo Leopold Society:** In addition to receiving the benefits listed above, members of The Aldo Leopold Society are invited guests at spring and fall IES science updates. Contact Ms. Jan Mittan at 914/677-5343 for information.

*For general information, call the IES Education Program Office at the Gifford House Visitor and Education Center: 914/677-5359 weekdays from 8:30 a.m. - 4:30 p.m.*

INSTITUTE OF  
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